

REMARKS

Applicants have considered the outstanding official action. It is respectfully submitted that the claims are directed to patentable subject matter as set forth hereinafter.

Restriction has been required under 35 U.S.C. §121 and §372 with regard to Group I, claims 1-7 drawn to a method, and Group II, claims 8-15 drawn to an apparatus. Applicants confirm the election of claims 1-7. Applicants reserve the right to file a divisional application as to the non-elected claims of Group II, i.e., claims 8-15. Claims 8-15 have been canceled herein without prejudice.

The Examiner states that the application does not contain an Abstract of the Disclosure. Applicants note that an Abstract appears in the application as filed at page 14. However, applicants are submitting herewith a new abstract on a separate sheet since the Abstract as filed was set forth in two paragraphs.

Claims 4-7 are objected to under 37 CFR 1.75(c) as being in improper form because a multiple dependent claim can not depend from any other multiple dependent claim. Applicants note that claims 4-7 have been rewritten as claims 19-22 and the dependencies therein corrected. Withdrawal of the objection and consideration of the subject matter of new claims 19-22 is requested.

Claims 1-3 are rejected under 35 U.S.C. §112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors at the time the application was filed had possession of the claimed invention. More specifically, the Examiner notes that in claim 1 there is no disclosure for "any other increase" as set forth; and as to claim 3, there is no disclosure as to the temperature being measured from "the upper side" and "with a different emissivity of the substrate being taken into consideration".

Claims 1-3 are also rejected under 35 U.S.C. §112, second paragraph, as being indefinite with respect to the phrase "any other increase" in claim 1 and "the upper side" in claim 3.

Applicants have rewritten elected claims 1-7 as new claims 16-22. In the rewriting of the claims, the matters raised by the Examiner as noted above were addressed. Specifically in claim 1, the phrase "any other increase" was deleted and the increase now referred to as a "linear, step-shaped or ramp-shaped increase". Support is present in the specification at page 7, lines 11-13. With respect to claim 3, "the upper side" has been rewritten as "an upper side". Further with respect to claim 3, the limitation as to the different emissivity of the substrate was deleted.

Accordingly, applicants respectfully request withdrawal of the §112, first and second paragraphs, rejections.

Claim 1 is rejected under 35 U.S.C. §103(a) as being unpatentable over JP 63-70940 (Kuriyama) in view of Hwang (U.S. Patent No. 5,705,232) and Kashino (U.S. Patent No. 5,097,605).

Claims 1-3 are rejected under 35 U.S.C. §103(a) as being unpatentable over JP 63-221618 (Ishikawa) in view of Hwang and Kashino.

The claimed invention provides a method which permits the drying of photo resist layers within a reasonable time. The drying method is suitable for various resists of different thicknesses and of different resist/substrate combinations as well as allows for producing masks presenting a high imaging precision. The claimed method is characterized in that only one drying system, i.e., IR radiation from an IR radiation source having a controllable power supply, is used for drying photo resist layers. Further, the power of the IR source is controlled on the basis of temperature or temperature-dependent parameter so that a predetermined development of temperature versus time occurs during the drying wherein the temperature is initially constant and then undergoes a linear, step-shaped or ramp-shaped increase throughout the drying.

The primary reference Kuriyama describes a drying method for resist layers of master disks used in data processing systems involving drying the resist layers by use of an IR-radiation source whose power is controlled based on the surface temperature of the master disk. Due to this teaching and practice, the drying temperature during the drying process is nearly constant. By controlling or adjusting the treatment heat based on the surface temperature of the disk, the heat is sought to be maintained essentially even. In contrast, when drying photo resist layers with applicants' claimed method, the drying temperature varies during the drying operation. In the claimed method, temperature variation is used for controlling the IR-radiation source by measuring the temperature or a parameter dependent on temperature in the vicinity of the photo resist layer in such a way that a predetermined development of temperature versus time, with the temperature initially being constant and then increasing, occurring during the drying operation. This increase of temperature can be a linear or step-shaped or ramp-shaped increase. Thus any number of forms of temperature rise are theoretically possible.

The other primary reference Ishikawa, describes a method for post-exposure baking of photo resist layers. A controller takes the temperature rising characteristics of the wafer into consideration and controls the irradiation

intensity of an IR-lamp using this data. Therefore the temperature and illuminance are monitored by a temperature sensor and an illuminance meter and then this data is fed back to the controller so as to perform feedback control to obtain the optimum temperature rising process. To use the process of Ishikawa, it is important that the photo resist layer has been pre-dried. Ishikawa therefore only describes how a certain temperature can be realized during post-exposure baking. One skilled in the relevant art is not taught how to dry thick and wet photo resist layers.

Hwang, which is separately combined with each of Kuriyama and Ishikawa, describes a drying method for drying so-called spin-on-material with the help of a lamp which can be an infrared, ultraviolet, tungsten halogen or mercury lamp. The lamp is only used for a limited period of time to provide optical curing. In contrast to the claimed invention, Hwang does not teach any method using an IR source that is controlled during the complete drying process, for example by using data measured with a temperature sensor.

Accordingly, none of Kuriyama, Ishikawa or Hwang describe a method useful for drying photo resist layers through only the use of an IR source controlled based on the predetermined development of temperature versus time wherein the temperature is initially constant and then undergoes an

increase. This avoids the formation of bubbles inside the photo resist layers.

The remaining secondary reference Kashino, also applied separately with each primary reference and Hwang, teaches a photo sensitive material processing apparatus having a processing chamber and a drying part. The drying part is disposed downstream of the processing part in a processing sequence for drying the material. The drying part consists of an IR drying system and a hot air current drying system. A controlling circuit controls the drying part so as to use the IR drying system on a constant-drying-rate-condition and to use the hot air current system on the decreasing-drying-rate-condition on the basis of the condition being distinguished by a distinguishing circuit. The distinguishing circuit distinguishes the condition of the material either as a constant-drying-rate-condition or a decreasing-drying-rate-condition on the basis of physical characteristics of the material. Therefore, Kashino describes a two stage method for drying photosensitive material. One stage uses a hot air current drying system and another stage uses an IR drying system. While the hot air current drying system can be controlled to use on a decreasing-drying-rate-condition, the IR drying system is only taught for use on a constant-drying-rate-condition. Therefore, one skilled in the art is not taught or suggested

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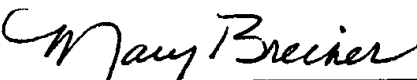
to provide a controllable IR-radiation source as claimed by applicants.

Accordingly, applicants respectfully submit that neither Kuriyama nor Ishikawa in combination with Hwang and Kashino teach or suggest the claimed invention. In particular, no teaching or suggestion is provided for drying a photo resist layer by exposure to IR radiation controlled on the basis of temperature or a temperature-dependent parameter measured in the vicinity of the photo resist layer so as to provide a predetermined development of temperature versus time which occurs during the drying operation, wherein the development is initially constant and thereafter undergoes a linear, step-shaped or ramp-shaped increase throughout the drying of the photo resist layer. Thus, withdrawal of the §103 rejections is respectfully requested.

Reconsideration and allowance of the claims is respectfully requested.

Respectfully submitted,

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